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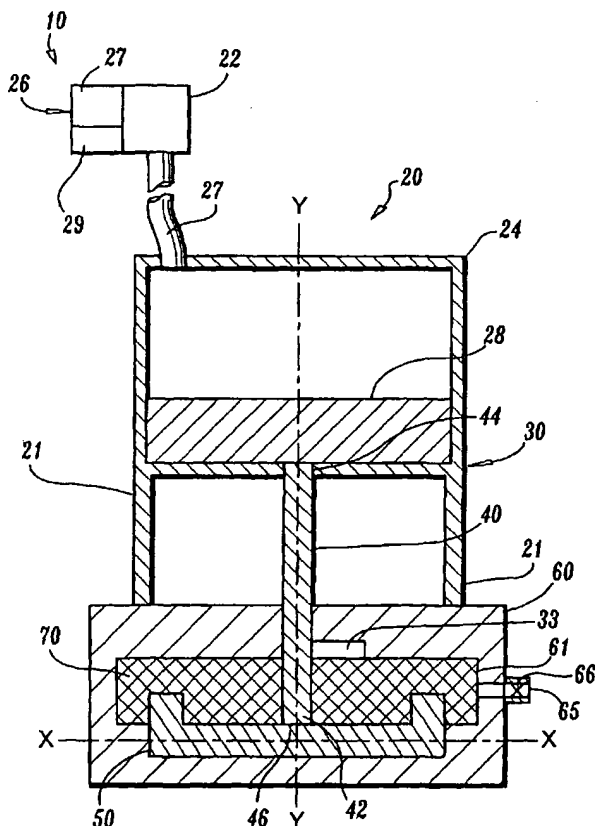
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[Continued on next page]

(54) Title: RETRACTABLE OVERMOLDED INSERT RETENTION APPARATUS



(57) Abstract: An insert retention apparatus for use with an insert mold tool includes an actuator (20) having a power system, a drive assembly and a control unit. The retention apparatus also includes an insert mold tool (60) and a retention post (40) operably connected to the drive assembly of the actuator (20). The retention post (40) is preferably configured for movement through the insert mold tool (60) between a first position wherein the retention post (40) engages and maintains a stamping (50) in fixed position within the insert mold tool (60) while a liquid resin is injected into the insert mold (60) to a second position wherein the retention post (40) is disengaged and moved relative to the stamping (50) prior to the resin completely curing. The invention also relates to a method of forming an overmold (70) on a stamping (50).

WO 02/081170 A1



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RETRACTABLE OVERMOLDED INSERT
RETENTION APPARATUS

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CROSS REFERENCE TO RELATED APPLICATION

This application claims the benefits of and priority to U.S. Provisional Patent
10 Application Serial No. 60/281,959 entitled: "RETRACTABLE OVERMOLDED
INSERT RETENTION MECHANISM" which was filed on April 6, 2001 by Terry
Duffin, the entire contents of this application are hereby incorporated by reference
herein.

15 **BACKGROUND**

1. Technical Field

The present disclosure relates to an apparatus and method for molding plastics.
More particularly, the present disclosure relates to an apparatus and method for
20 injection molding an overmold on an insert or stamping.

2. Background of Related Art

Injection molding machines typically use one or more so-called insert mold
tools to form an overmold on an insert or stamping. Generally prior to formation of the
25 overmold, the insert mold tool is disposed in its disassembled configuration to enable
positioning of the insert or stamping within the insert mold tool. The insert mold tool
is, in turn, installed on (or otherwise cooperates with) an injection molding machine
which infuses a liquid resin into the insert mold tool under pressure. The interior
dimensions of the insert mold tool define the shape of the overmold resin as it cools and
30 cures into a solid overmold and bonds to the stamping.

In some cases, a series of fixed extensions are seated within the insert mold tool and are designed to retain/fix the stamping in position within the insert mold tool during the injection process. Typically, the extensions contact parts of the stamping that are raised or otherwise extend above or beyond the overmold portion to minimize their impact on the shape of the overmold as it cures while insuring proper positioning of the stamping within the overmold insert tool. It is known that stampings not held in position during the injection process are vulnerable to being unseated due to the high pressures and temperatures normally associated with infusing the liquid overmold resin into the insert mold tool.

Utilizing the fixed extensions also has some disadvantages. More particularly, the points of affixation to the stamping tend to obstruct the molding process, i.e., as the overmold cures, the fixed extensions leave voids or pockets in the overmold which must be subsequently filled. As can be appreciated, this requires additional manufacturing steps, e.g., potting of the voids with a similar resin, a quick curing epoxy-based material, or the like. As a result, the injection molding process becomes more time consuming and typically requires additional quality control especially in certain applications which must meet specific code requirements, e.g., electrosurgical applications. For example, in many of these instances the voids have to be potted by hand, cured, inspected, and then the surface finished to meet the final requirements of the product. Thus, many known insert overmold applications require extra time-consuming steps and additional materials and resources to fill the voids left in the overmolded insert by the fixed extensions.

It would therefore be desirable to perform injection molding in a single step process utilizing an apparatus and method which retains the stamping in a seated position in the insert mold tool during the injection molding process and does not create voids in the overmolded insert when cured.

SUMMARY

The present disclosure relates to an insert retention apparatus for use with an insert mold tool which includes an actuator having a power system, a drive assembly
5 and a control unit. The retention apparatus also includes an insert mold tool and at least one retention post which is operably connected to the drive assembly of the actuator. The retention post is configured for movement through the insert mold tool by the drive assembly between at least two positions; a first position wherein the retention post engages and maintains a stamping in fixed position within the insert mold
10 tool while a liquid resin is injected into the insert mold tool; and a second position wherein the retention post is disengaged and moved relative to the stamping prior to the resin completely curing. Preferably, the drive assembly includes a piston which controls the movement of the retention post from the first to second positions.

In one embodiment, the insert retention apparatus includes a sensor which
15 initiates disengagement and withdrawal of the retention post from the stamping after sensing a predetermined condition. Alternatively, the control unit can include a timer which initiates disengagement and withdrawal of the retention post from the stamping after a predetermined time period.

In another embodiment, the insert mold tool includes an infusion valve which
20 is utilized to inject resin into the insert mold tool. The infusion valve may also be configured to initiate disengagement and withdrawal of the retention post from the stamping after a predetermined amount of resin flows therethrough.

The present disclosure also relates to a method of forming an overmold on a stamping and includes the steps of providing an actuator including a power system, a
25 drive assembly and a control unit. An insert mold tool and at least one retention post is also provided. The insert mold tool is operably connected to the drive assembly of the actuator.

The method further includes the step of engaging a stamping with the retention post to maintain the stamping in fixed position within the insert mold tool. Thereafter,
30 a liquefied overmold resin is injected under pressure into the insert mold tool. The drive assembly is then activated to disengage the retention post from the stamping and

withdraw the retention post through the insert mold tool in response to a signal from the control unit. The overmold resin is then allowed to cure and bond to the stamping.

In one method according to the present disclosure, after the step of activating the drive assembly to disengage the retention post, additional resin is injected into the insert mold tool. In another method, the control unit signals the disengagement and withdrawal of the retention post after approximately 50% of the insert mold tool is filled with overmold resin.

According to additional methods of the present disclosure, the control unit signals the disengagement and withdrawal of the retention post upon the expiration of a predetermined time period or based upon a specific physical parameter of the resin which is attained during the curing process, e.g., hardness, viscosity and/or pressure.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the presently disclosed retractable overmolded insert retention apparatus and method are described herein with reference to the drawings, wherein:

FIG. 1 is a cross-sectional view of a retractable overmolded insert retention apparatus in accordance with the present disclosure showing the insert retention apparatus in a first position with an insert retention post retaining a stamping in a seated position within an insert mold tool; and

FIG. 2 is the cross-sectional view of the retention apparatus of FIG. 1 shown in a second position wherein the retention post is separated from the stamping during the curing process.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now in specific detail to the drawings in which like reference numerals identify similar or identical elements throughout the several views, one embodiment of a retractable overmolded insert retention apparatus is shown in Figs. 1 and 2 and is generally identified as retention apparatus 10. Fig. 1 illustrates the

retention apparatus 10 in a first position prior to injection of an overmold resin 70 into the insert mold tool and Fig. 2 illustrates the position of the retention apparatus 10 after injection and/or during the curing process of the overmold resin 70.

As shown, retention apparatus 10 is mounted to and positioned for use with an insert mold tool 60 of an injection molding machine (not shown). Retention apparatus 10 includes an actuation system (or actuator) 20 which cooperates with an insert retention assembly 30 to position a retention post 40 into and out of contact with a stamping 50 mounted or seated within the insert mold tool 60.

Insert mold tool 60 includes longitudinal axes X, Y, and Z defined therethrough. Longitudinal axis Z extends perpendicularly to plane X-Y but is not shown. Insert mold tool 60 includes an internal cavity 61 which is dimensioned to define the external shape of the overmold resin 70 when cured. In one embodiment, the overmold 70 is made from a plastic material which electrically insulates the stamping 50 during an electrosurgical procedure. It is envisioned that other types of overmold resins may be used to form the overmold 70 depending upon a particular purpose or to achieve a specific result. Generally, the overmold 70 is injected in a liquid form under pressure through an infusion valve 65 disposed in the insert mold tool 60. Infusion valve 65 can be oriented at any angle relative to the stamping 50 to infuse overmold resin 70 into the insert mold tool 60.

Insert retention assembly 30 includes the retention post 60 which is movable via piston 28 from a first position which retains the stamping 50 in fixed position within the insert mold tool 60 to a second position which disengages the retention post 60 from the stamping to allow curing of the overmold 70. As best shown in Fig. 1, retention post 40 maintains stamping 50 in a fixed position prior to the initiation of the injection molding process. Retention post 40 includes a distal end 42 and a proximal end 44 and is generally movable along longitudinal axis Y by the drive assembly 24. Retention post 40 is preferably rod-like or cylindrical, however, it is envisioned that retention post 40 can be configured in a variety of geometric shapes and circumferences which have suitable structural integrity to maintain the stamping 50 in a fixed position during the infusion of the liquefied overmold resin 70 into the insert mold tool 60.

In one embodiment according to the present disclosure, retention post 40 is

made of stainless steel and has a surface finish which minimizes bonding with the liquefied overmold resin 70 during infusion and curing. It is envisioned that the retention post 40 can be made from a variety of different materials or combinations of materials which minimize or impede bonding with the overmold resin 70 during curing.

5 Moreover, it is contemplated that the retention post 40 may be coated with one or more materials which reduce or minimize bonding with the overmold resin 70 during the infusion and curing processes.

It is also envisioned that the distal end 42 of retention post 40 can be configured to include one or more mechanical interfaces which cooperate with one or more
10 corresponding mechanical interfaces disposed on stamping 50 to maintain the stamping 50 in a fixed position within the insert molding tool 60 during the infusion and curing processes. For example, the distal end 42 may include one or more a detents (not shown) and the stamping may include corresponding recesses (not shown) which align and seat the stamping 50 within the insert mold tool 60. As can be appreciated,
15 different combinations of mechanical interfaces can be designed such that the inter-engagement of these mechanical interfaces restrict the movement of the stamping 50 along the X, Y and Z axes.

As illustrated in Figs. 1 and 2, actuator 20 includes a power system 22, a drive assembly 24, and a control unit 26. The insert retention assembly 30 (which includes
20 the piston 28 and the retention post 40) is preferably housed within the drive assembly 24 and mounts atop a standoff 21. Alternatively, the insert retention assembly 30 could stand alone and mechanically or electromechanically interact with the drive assembly 24 depending upon a particular purpose or to achieve a specific result. In one preferred embodiment, actuator 20 partially mounts atop insert mold tool 60 and is remotely
25 controlled by power system 22. Alternatively, the power system 22 can be mounted or otherwise engaged atop the drive assembly 24. It is also envisioned that actuation system 20 can use one or more of the existing drive mechanisms of the injection molding machine in combination with an independent power system 22 to control the insert retention assembly 30. It is contemplated that power system 22 may utilize one
30 or more hydraulic, pneumatic, electrical, or electro-mechanical systems (or combinations thereof) to control the mechanical movement of the retention assembly

30.

As mentioned above and as shown in the comparison of Figs. 1 and 2, drive assembly 24 is pneumatically driven and includes piston 28 which moves retention post 40 from a first position wherein the distal end 42 of the retention post 40 engagably maintains stamping 50 in a fixed position within insert tool 60 to a second position wherein the retention post is disengaged from stamping 50 at a predetermined position relative to insert mold tool 60 to promote curing of the overmold resin 70. A stop member (not shown) may be employed to regulate the distance and pressure applied by retention post 40 when in contact with stamping 50 in the seated position. The rate of withdrawal of the retention post 40 relative to the stamping 50 may be fixed or variable depending upon one or more curing parameters associated with the injection molding process.

As shown in Figs. 1 and 2, the control unit 26 and power system are connected to the drive assembly 24 by a power supply 27. The control unit 26 cooperates with the insert molding injection machine and the infusion valve 65 to control the drive assembly 24 to move the retention assembly 30, i.e., piston 28 and retention post 40, prior to the overmold resin 70 completely curing. As can be appreciated, the timing of the disengagement and withdrawal of the retention post 40 is important to both the proper formation of the overmold resin 70 during curing to encapsulate and bond to the stamping 50 and to prevent the formation of voids and/or pockets in the cured overmold 70 which would have to be potted in a subsequent manufacturing step.

Moreover, the timing of the disengagement and withdrawal of the retention post 40 assures the proper and complete formation of the overmold resin 70 atop the stamping 50, i.e., without pockets, which also electrical insulates the remaining portions of the electrosurgical instrument. In other words, the complete formation of the overmold resin 70 atop the stamping without void or pockets reduces the risk of stray electrical currents emanating from the stamping during electrosurgical activation. As explained in more detail below, the voids or pockets may also be filled or potted in a subsequent step (during the final stages of the fill phase or during the hold and fill phase as mentioned below) which backfills the pockets or voids after removal of the retention post 40 but before the overmold resin 70 has completely cured.

It is envisioned that the control unit 26 may incorporate a timing device 27 (or a computer algorithm) which signals the drive assembly 24 to disengage and withdraw the retention post 40 from the stamping 50 after a predetermined time period from the initiation of the injection process. It is also envisioned that the withdrawal of the retention post 40 will generally coincide with the time when the structural integrity of the overmold resin 70 is strong enough to support/retain the stamping 50 in the desired orientation and position in the insert mold tool 60 until the overmold resin 70 has completely cured.

Alternatively, the control unit 26 may include a sensing device 29 which detects one or more curing parameters to initiate withdrawal of the retention post 40 when the parameters are satisfied, e.g., temperature, weight, viscosity, etc. Additional devices may also be employed which cooperate with the control unit 26 and infusion valve 65 to measure the quantity and/or rate that the overmold resin 70 is being injected into the insert mold tool 60 and to initiate withdrawal of the retention post 40 once a certain threshold is satisfied. For example, the infusion valve may include a gauge 66 which measures the flow quantity and/or flow rate during the injection process. The control unit 26 can monitor the gauge 66 and disengage and withdraw the retention post 40 once a certain quantity of resin 70 has been injected into the insert mold tool 60. A durometer 33 may also be employed proximate the insert molding tool 60 to measure the hardness of the overmold during the curing process which could initiate withdrawal of the retention post 40.

Additional sensors (not shown) may be associated with the retention post 40 for the measuring the position of the retention post 40 relative to stamping 50 or measuring the strength of mechanical engagement between the stamping 50 and the retention post 40. These types of sensor systems could be configured to provide feedback to the control unit 26 ensuring proper seating, positioning and engagement of the stamping 50 within the insert tool 60.

In use, one or more retention posts 40 are moved to the first position to engage and maintain the stamping 50 in a fixed position within the insert mold tool 60. An overmold resin 70 is then injected in liquid form into the insert mold tool 60 through the infusion port 65 by the injection molding machine at approximately 8,000 psi.

Generally, this so-called "fill phase" lasts approximately 0.5 to 0.75 seconds. However, longer fill phases are also envisioned, e.g., 5, 10 seconds, or more). After a sufficient quantity of a overmold resin 70 has been injected into the insert mold tool 60 or after a predetermined time period, the retention post is disengaged with the stamping 50 and
5 withdrawn from the insert mold tool 60.

Preferably, the retention post 40 is disengaged and withdrawn from the insert mold tool such that the tip 46 of the retention post 40 is approximately flush with the inside cavity 61 of insert mold tool 60 which reduces the amount of excess resin extruding from the overmold. As mentioned above, one or more sensors 29 may also
10 be employed to also initiate disengagement and withdrawal of the retention post 40.

It is contemplated that retention post 40 can be withdrawn during the fill phase or in a subsequent "hold and pack phase" in which additional overmold resin 70 is injected to compensate for shrinkage during the cooling and curing of the overmold resin 70. In one embodiment, retention post 40 is disengaged from stamping after the
15 fill phase is approximately 50-95% complete. In another embodiment, the retention post 40 is withdrawn when approximately 33-100% of the fill phase is complete or when approximately 25% of the hold and fill phase is complete.

As can be appreciated, the timing of the withdrawal is dependent upon various parameters which change according to the particular resin being used, e.g., curing
20 temperature, curing pressure, curing rate, product architecture, etc. The timing of the withdrawal of the retention post 40 is also important to assure that any voids or pockets left in the overmold 70 a result of withdrawal of the retention post 40 are filled during the final stages of the fill phase or during the hold and fill phase. For example, when the function of the overmold 70 is to form a dielectric insulative coating over a portion
25 of the stamping 50 for electrosurgical purposes, the retention post 40 should be withdrawn in a time frame which ensures that the required minimum thickness of the insulative overmold 70 is satisfied.

From the foregoing and with reference to the various figure drawings, those skilled in the art will appreciate that certain modifications can also be made to the
30 present disclosure without departing from the scope of the same. For example, although the retention apparatus 10 is shown supporting one stamping 50 for use with forming

one overmold 70, the retention apparatus 10 can be configured to support multiple stampings 50 within a single insert mold tool 60 which increases production while also increasing overall manufacturing quality. This may particularly advantageous in automated configurations.

5 While rod 40 is shown as moving along longitudinal axis Y approximately perpendicular to the longitudinal axis X of stamping 50, actuation system 20 may be configured to both translate retention post 40 along axis Y and rotate retention post 40 about axis Y to facilitate disengagement with stamping 50, i.e., the combined rotation and translation movement of retention post 40 will reduce the resin-to-retention post 40
10 bond during withdrawal. Actuation system 20 may also be configured to support and subsequently move retention post 40 at an angle relative to stamping 50 depending upon a particular purpose and/or to facilitate removal of the retention post 40 to promote curing of the overmold 70.

 Although only one retention post 40 is depicted herein, it is contemplated that
15 more than one retention post 40 may be employed with insert mold tool 60. For example, in additional embodiments, the insert retention assembly 30 may include a series of retention posts 40 which cooperate to maintain the stamping 50 in position within the insert mold tool 60.

 While only one embodiment of the disclosure has been described, it is not
20 intended that the disclosure be limited thereto, as it is intended that the disclosure be as broad in scope as the art will allow and that the specification be read likewise. Therefore, the above description should not be construed as limiting, but merely as exemplifications of a preferred embodiment. Those skilled in the art will envision other modifications within the scope and spirit of the claims appended hereto.

25

WHAT IS CLAIMED IS:

1. An insert retention apparatus for use with an insert mold tool, comprising:
an actuator including a power system, a drive assembly and a control
5 unit;
an insert mold tool; and
at least one retention post operably connected to the drive assembly of
the actuator configured for movement through the insert mold tool between a first
position wherein the at least one retention post engages and maintains a stamping in
10 fixed position within the insert mold tool while a liquid resin is injected into the insert
mold tool to a second position wherein the at least one retention post is disengaged and
moved relative to the stamping prior to the resin completely curing.
2. An insert retention apparatus according to claim 1 wherein the control
15 unit includes a timer which initiates disengagement and withdrawal of the retention post
from the stamping after a predetermined time period.
3. An insert retention apparatus according to claim 1 further comprising a
sensor which initiates disengagement and withdrawal of the retention post from the
20 stamping after sensing a predetermined condition.
4. An insert retention apparatus according to claim 1 wherein the insert
mold tool includes an infusion valve, the infusion valve initiates disengagement and
withdrawal of the retention post from the stamping after a predetermined amount of
25 resin flows through the infusion valve.
5. An insert retention apparatus according to claim 1 wherein the drive
assembly includes a piston which controls the movement of the retention post from the
first to second positions.

6. A method of forming an overmold on a stamping comprising the steps of:
- providing:
- an actuator including a power system, a drive assembly and a control
- 5 unit;
- an insert mold tool; and
- at least one retention post operably connected to the drive assembly of the actuator;
- engaging a stamping with the retention post to maintain the stamping in
- 10 fixed position within the insert mold tool;
- injecting an overmold resin under pressure into the insert mold tool;
- activating the drive assembly to disengage the retention post from the stamping and withdraw the retention post through the insert mold tool in response to a signal from the control unit; and
- 15 allowing the overmold resin to cure and bond to the stamping.
7. A method according to claim 6 wherein after the step of activating the drive assembly to disengage the retention post, the method further includes the step of:
- injecting additional resin into the insert mold tool.
- 20
8. A method according to claim 6 wherein the control unit signals the disengagement and withdrawal of the retention post after approximately 50% of the insert mold tool is filled with resin.
- 25
9. A method according to claim 6 wherein the control unit signals the disengagement and withdrawal of the retention post when about 50% to about 95% of the resin has been injected into the insert mold tool.

10. A method according to claim 6 wherein the control unit signals the disengagement and withdrawal of the retention post based upon a reading from a durometer.
- 5 11. A method according to claim 6 wherein the control unit signals the disengagement and withdrawal of the retention post based upon the expiration of a predetermined time period.
- 10 12. A method according to claim 6 wherein the control unit signals the disengagement and withdrawal of the retention post based upon a predetermined pressure reading.
- 15 13. A method according to claim 6 wherein the control unit signals the disengagement and withdrawal of the retention post based upon a predetermined viscosity.

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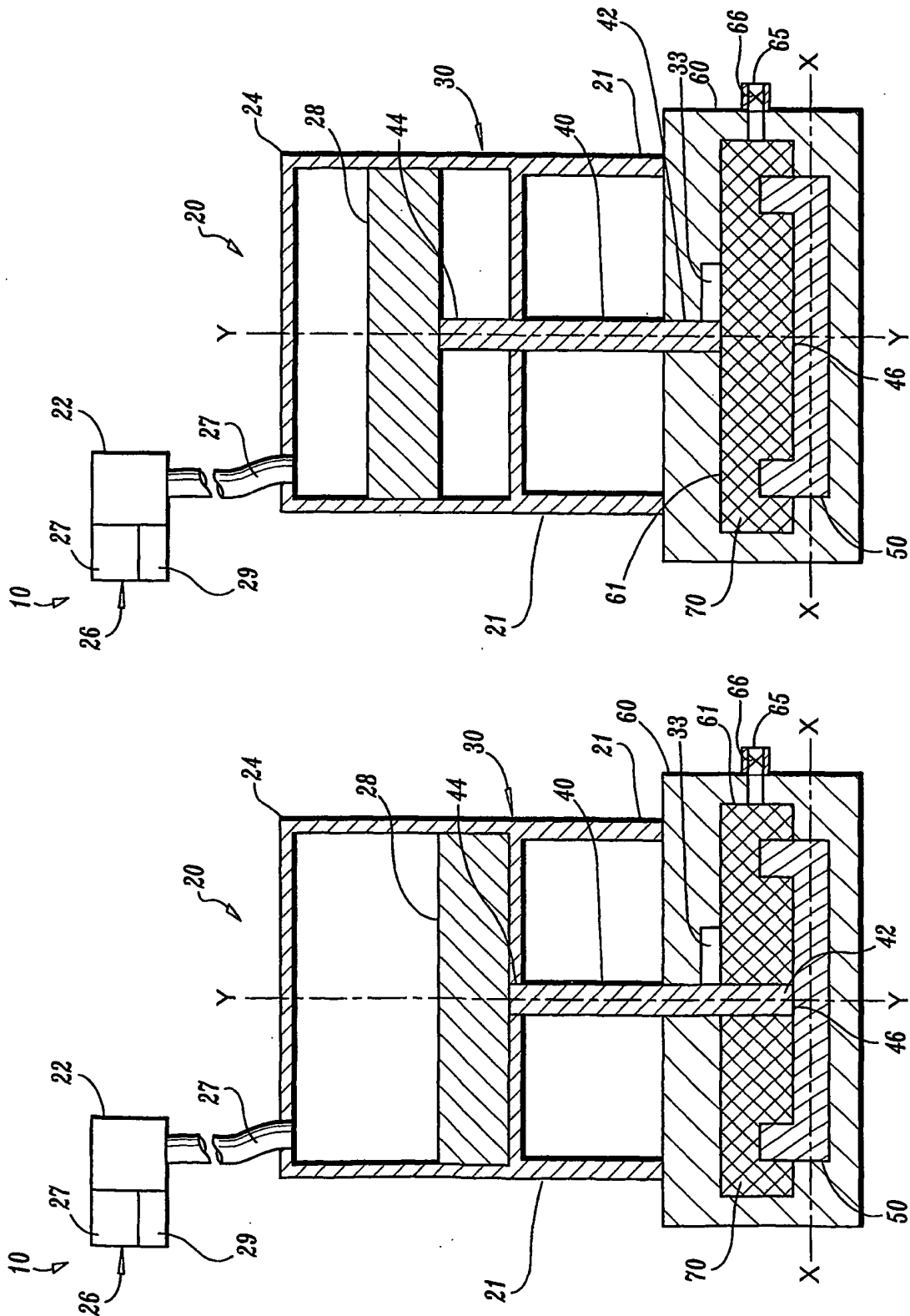


FIG. 2

FIG. 1

INTERNATIONAL SEARCH REPORT

 International Application No
 PCT/US 02/11097

 A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 B29C45/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B29C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

PAJ

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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents:

- *A* document defining the general state of the art which is not considered to be of particular relevance
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X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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INTERNATIONAL SEARCH REPORT

International Application No
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